

In addition to jobs created by increased demand for electrical work, many openings will occur each year as electricians transfer to other occupations, retire, or leave the labor force for other reasons. Because of their lengthy training and relatively high earnings, a smaller proportion of electricians than other craft workers leave their occupation each year. The number of retirements is expected to rise, however, as more electricians reach retirement age.

Employment of construction electricians, like that of many other construction workers, is sensitive to changes in the economy. This results from the limited duration of construction projects and the cyclical nature of the construction industry. During economic downturns, job openings for electricians are reduced as the level of construction declines. Apprenticeship opportunities also are less plentiful during these periods.

Although employment of maintenance electricians is steadier than that of construction electricians, those working in the automotive and other manufacturing industries that are sensitive to cyclical swings in the economy may be laid off during recessions. Also, efforts to reduce operating costs and increase productivity through the increased use of contracting out for electrical services may limit opportunities for maintenance electricians in many industries. However, this should be partially offset by increased demand by electrical contracting firms.

Job opportunities for electricians also vary by area. Employment opportunities follow the movement of people and businesses among States and local areas, and reflect differences in local economic conditions. The number of job opportunities in a given year may fluctuate widely from area to area. Some parts of the country may experience an oversupply of electricians, for example, while others may have a shortage.

Earnings

In 1998, median hourly earnings of electricians were \$16.98. The middle 50 percent earned between \$12.69 and \$22.34. The lowest 10 percent earned less than \$10.07 and the highest 10 percent earned more than \$30.99. Median hourly earnings in the industries employing the largest number of electricians in 1997 are shown below:

Motor vehicles and equipment	\$21.50
Local government, except education and hospitals	18.30
Electrical work	16.20
Personnel supply services	12.60

Depending on experience, apprentices usually start at between 30 and 50 percent of the rate paid to experienced electricians. As they become more skilled, they receive periodic increases throughout the course of the apprenticeship program. Many employers also provide training opportunities for experienced electricians to improve their skills.

Many construction electricians are members of the International Brotherhood of Electrical Workers. Among unions organizing maintenance electricians are the International Brotherhood of Electrical Workers; the International Union of Electronic, Electrical, Salaried, Machine, and Furniture Workers; the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; and the United Steelworkers of America.

Related Occupations

To install and maintain electrical systems, electricians combine manual skill and knowledge of electrical materials and concepts. Workers in other occupations involving similar skills include air-conditioning mechanics, cable installers and repairers, electronics mechanics, and elevator installers and repairers.

Sources of Additional Information

For details about apprenticeships or other work opportunities in this trade, contact the offices of the State employment service, the State apprenticeship agency, local electrical contractors or firms that

employ maintenance electricians, or local union-management electrician apprenticeship committees. This information may also be available from local chapters of the Independent Electrical Contractors, Inc.; the National Electrical Contractors Association; the Home Builders Institute; the Associated Builders and Contractors; and the International Brotherhood of Electrical Workers.

Additional information on apprenticeships is available from:

- ☛ The National Joint Apprenticeship and Training Committee for the Electric Industry, 301 Prince Georges Blvd., Suite D, Upper Marlboro, MD 20744.
- ☛ For general information about the work of electricians, contact:
 - ☛ Independent Electrical Contractors, Inc., 2010-A Eisenhower Avenue Alexandria, VA 22314.
 - ☛ National Electrical Contractors Association (NECA), 3 Metro Center, Suite 1100, Bethesda, MD 20814. Internet: <http://www.recant.org>
 - ☛ International Brotherhood of Electrical Workers (IBEW), 1125 15th St. NW., Washington, DC 20005. Internet: <http://www.IBEW.org>
 - ☛ Associated Builders and Contractors, 1300 North 17th St., Rosslyn, VA 22209.
 - ☛ Homebuilders Institute, National Association of Home Builders, 1201 15th St. NW., Washington, DC 20005.

Elevator Installers and Repairers

(O*NET 85932)

Significant Points

- Elevator installers and repairers learn the trade through years of on-the-job training, usually through a program run by their union.
- Almost 75 percent of elevator installers and repairers are union members—a greater proportion than nearly any other occupation.
- The combination of slow employment growth and the high pay these workers earn should continue to result in low job turnover and relatively few job openings.

Nature of the Work

Elevator installers and repairers—also called *elevator constructors* or *elevator mechanics*—assemble, install, and replace elevators, escalators, dumbwaiters, moving walkways, and similar equipment in new and old buildings. Once the equipment is in service, they maintain and repair it, as well. They are also responsible for modernizing older equipment.

To install, repair, and maintain modern elevators, which are almost all electronically controlled, elevator installers and repairers must have a thorough knowledge of electronics, electricity, and hydraulics. Many elevators today are installed with microprocessors, which are programmed to constantly analyze traffic conditions to dispatch elevators in the most efficient manner. With these computer controls, it is now possible to get the greatest amount of service with the least number of cars.

When installing a new elevator, installers and repairers begin by studying blueprints to determine the equipment needed to install rails, machines, car enclosures, motors, pumps, cylinders, and plunger foundations. Once this has been determined, they begin equipment installation. Working on scaffolding or platforms, installers bolt or weld steel rails to the walls of the shaft to guide the elevator.

Elevator installers put in electrical wires and controls by running tubing, called conduit, along a shaft's walls from floor to floor. Once in place, mechanics pull plastic-covered electrical wires through the conduit. They then install electrical components and related devices required at each floor and at the main control panel in the machine room.

Installers bolt or weld together the steel frame of an elevator car at the bottom of the shaft, install the car's platform, walls, and doors, and

attach guide shoes and rollers to minimize the lateral motion of the car, as it travels through the shaft. They also install the outer doors and door frames at the elevator entrances on each floor.

For cabled elevators, these workers install geared or gearless machines with a traction drive wheel that guides and moves heavy steel cables connected to the elevator car and counterweight. (The counterweight moves in the opposite direction from the car and aids in its swift and smooth movement.) Elevator installers also install elevators in which a car sits on a hydraulic plunger that is driven by a pump. The plunger pushes the elevator car up from underneath, similar to a lift in an auto service station.

Installers and repairers also install escalators. They put in place the steel framework, the electrically powered stairs, and the tracks and install associated motors and electrical wiring. In addition to elevators and escalators, they also may install devices such as dumbwaiters and material lifts—which are similar to elevators in design—moving walkways, stair lifts, and wheelchair lifts.

The most highly skilled elevator installers and repairers, called “adjusters,” specialize in fine-tuning all the equipment after installation. Adjusters make sure that an elevator is working according to specifications, such as stopping correctly at each floor within a specified time. Once an elevator is operating properly, it must be maintained and serviced regularly to keep it in safe working condition. Elevator maintenance mechanics generally do preventive maintenance—such as oiling and greasing moving parts, replacing worn parts, testing equipment with meters and gauges, and adjusting equipment for optimal performance. They also troubleshoot and may be called in to do emergency repairs.



Elevator installers need a working knowledge of electronics, electricity, and hydraulics.

A service crew usually handles major repairs—for example, replacing cables, elevator doors, or machine bearings. This may require cutting torches or rigging equipment—tools a maintenance mechanic would not normally carry. Service crews also do major modernization and alteration work, such as moving and replacing electrical motors, hydraulic pumps, and control panels.

Elevator installers and repairers usually specialize in installation, maintenance, or repair work. Maintenance and repair workers generally need more knowledge of electricity and electronics than installers do, because a large part of maintenance and repair work is troubleshooting. Similarly, construction adjusters need a thorough knowledge of electricity, electronics, and computers, to ensure that newly installed elevators operate properly.

Working Conditions

Most elevator installers and repairers work a 40-hour week. However, maintenance and service mechanics often work overtime when repairing essential elevator equipment and are sometimes on 24-hour call. Maintenance mechanics, unlike most elevator installers, are on their own most of the day and typically service the same elevators periodically.

Elevator installers lift and carry heavy equipment and parts and may work in cramped spaces or awkward positions. Hazards include falls, electrical shock, muscle strains, and other injuries related to handling heavy equipment. Because most of their work is performed indoors in buildings under construction or in existing buildings, elevator installers and repairers lose less work time due to inclement weather than other building trades workers.

Employment

Elevator installers and repairers held about 30,000 jobs in 1998. Most were employed by special trade contractors. Others were employed by field offices of elevator manufacturers, wholesale distributors, small, local elevator maintenance and repair contractors, or by government agencies or businesses that do their own elevator maintenance and repair.

Training, Other Qualifications, and Advancement

Most elevator installers and repairers apply for their jobs through a local of the International Union of Elevator Constructors. Applicants for trainee positions must be at least 18 years old, have a high school diploma or equivalent, and pass an aptitude test. Good physical condition and mechanical aptitude also are important.

Elevator installers and repairers learn their trade in a program administered by local joint educational committees representing the employers and the union. These programs, through which the trainee learns everything from installation to repair, combine on-the-job training with classroom instruction in electrical and electronic theory, mathematics, applications of physics, and safety. In nonunion shops they may complete training programs sponsored by independent contractors.

Generally, trainees or helpers must complete a 6-month probationary period. After successful completion, they work toward becoming fully qualified mechanics within 4 to 5 years. To be classified as a fully qualified mechanic, union trainees must pass a standard mechanics examination administered by the National Elevator Industry Educational Program. Most States and cities also require elevator constructors to pass a licensing examination.

Most trainees or helpers assist experienced elevator installers and repairers. Beginners carry materials and tools, bolt rails to walls, and assemble elevator cars. Eventually, trainees learn more difficult tasks, such as wiring, which requires knowledge of local and national electrical codes.

High school courses in electricity, mathematics, and physics provide a useful background. As elevators become increasingly sophisticated, workers may find it necessary to acquire more advanced formal education—for example, in postsecondary technical school or junior college—with an emphasis on electronics. Workers with more formal education usually advance more quickly than their counterparts.

Many elevator installers and repairers also receive training to become familiar with a company's particular equipment from their employers or through manufacturers. Retraining is very important to keep abreast of technological developments in elevator repair. In fact, union elevator constructors typically receive continual training throughout their careers, either through correspondence courses, seminars, or formal classes. Although voluntary, this training greatly improves one's chances for promotion.

Some installers may receive further training in specialized areas and advance to mechanic-in-charge, adjuster, supervisor, or elevator inspector. Adjusters, for example, may be picked for the position because they possess particular skills or are seen to be electronically inclined. Other workers may move into management, sales, or product design jobs.

Job Outlook

Employment of elevator installers and repairers is expected to increase as fast as the average for all occupations through the year 2008, but relatively few new job opportunities will be generated because the occupation is small. Replacement needs, another source of jobs, also will be relatively low. This is, in part, because a substantial amount of time is invested in specialized training that yields high earnings, so workers tend to remain in these jobs. The job outlook for new workers is largely dependent on activity in the construction industry, and opportunities may vary from year to year as conditions within the industry change. Job prospects should be best for those with postsecondary training in electronics or more advanced formal education.

Demand for elevator installers and repairers will increase as equipment ages and needs repairs and as the construction of new buildings with elevators and escalators increases. Growth also should be driven by the need to continually update and modernize old equipment, including improvements in appearance and the installation of increasingly sophisticated equipment and computerized controls. Because it's desirable that equipment be always kept in good working condition, economic downturns will have less of an effect on employment of elevator maintenance and repair mechanics than on other occupations. The need for people to service elevators and escalators should increase, as equipment becomes more intricate and complex.

Earnings

Median hourly earnings of elevator installers and repairers in 1998 were \$23.01. The middle 50 percent earned between \$18.41 and \$32.20. The lowest 10 percent earned less than \$14.22 and the top 10 percent earned more than \$40.70.

In addition to free continuing education, elevator installers and repairers receive basic benefits enjoyed by most other workers.

The proportion of elevator installers and repairers who are union members is higher than nearly any other occupation. Almost 75 percent of elevator installers and repairers are members of a union, compared to 14 percent in all occupations, and 22 percent for other craft and repair occupations. Most elevator installers and repairers belong to the International Union of Elevator Constructors.

Related Occupations

Elevator installers and repairers combine electrical and mechanical skills with construction skills, such as welding, rigging, measuring, and blueprint reading. Other occupations that require many of these skills are boilermaker, electrician, industrial machinery repairer, millwright, sheet metal worker, and structural and reinforcing metal workers.

Sources of Additional Information

For further details about opportunities as an elevator installer and repairer, contact elevator manufacturers, elevator repair and maintenance contractors, a local of the International Union of Elevator Constructors, or the nearest local public employment service office.

Glaziers

(O*NET 87811)

Significant Points

- Glaziers learn the trade on the job, either through a formal apprenticeship or by working as helpers to experienced glaziers.
- Glazier employment is expected to increase slowly due to the slow growth anticipated in construction.

Nature of the Work

Glass serves many uses in modern buildings. Insulated and specially treated glass keeps in warmed or cooled air, and provides good condensation and sound control qualities; tempered and laminated glass makes doors and windows more secure. In large commercial buildings, glass panels give skyscrapers a distinctive look while reducing the need for artificial lighting. The creative use of large windows, glass doors, skylights, and sun room additions make homes bright, airy, and inviting.

Glaziers are the workers responsible for selecting, cutting, installing, replacing, and removing all types of glass. They generally work on one of several types of projects. Residential glazing involves work such as replacing glass in home windows, installing glass mirrors, shower doors and bathtub enclosures, and glass for table tops and display cases. On commercial interior projects, glaziers install items such as heavy, often etched, decorative room dividers and windows with speak holes and security glazing. Glazing projects may also involve replacement of storefront windows for establishments such as, supermarkets, auto dealerships, and banks. In the construction of large commercial buildings, glaziers build metal framework extrusions and install glass panels or curtainwalls.

Besides working with glass, glaziers may also work with plastics, granite, marble, and similar materials used as glass substitutes. They may mount steel and aluminum sashes or frames and attach locks and hinges to glass doors. For most jobs, the glass is precut and mounted in frames at a factory or a contractor's shop. It arrives at the job site ready for glaziers to position and secure it in place. They may use a crane or hoist with suction cups to lift large, heavy pieces of glass. They then gently guide the glass into position by hand.

Once glaziers have the glass in place, they secure it with mastic, putty, or other pastelike cement, or with bolts, rubber gaskets, glazing compound, metal clips, or metal or wood molding. When they secure glass using a rubber gasket—a thick, molded rubber half-tube with a split running its length—they first secure the gasket around the perimeter within the opening, then set the glass into the split side of the gasket, causing it to clamp to the edges and hold the glass firmly in place.

When they use metal clips and wood molding, glaziers first secure the molding to the opening, place the glass in the molding, and then force spring-like metal clips between the glass and the molding. The clips exert pressure and keep the glass firmly in place.

When a glazing compound is used, glaziers first spread it neatly against and around the edges of the molding on the inside of the opening. Next, they install the glass. Pressing it against the compound on the inside molding, workers screw or nail outside molding that loosely holds the glass in place. To hold it firmly, they pack the space between the molding and the glass with glazing compound and then trim any excess material with a glazing knife.

For some jobs, the glazier must cut the glass manually at the job site. To prepare the glass for cutting, glaziers rest it either on edge on a rack or "A-frame," or flat against a cutting table. They then measure and mark the glass for the cut.

Glaziers cut glass with a special tool that has a very hard metal wheel about 1/6 inch in diameter. Using a straightedge as a guide, the glazier presses the cutter's wheel firmly on the glass, guiding and rolling it carefully to make a score just below the surface. To help the cutting tool move smoothly across the glass, workers brush a thin layer of oil